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Remote Monitoring of Trenitalia rolling stock: the Telediagnostic System

EMRailS 2019

Alfredo Biancucci - TRENITALIA

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Summary

- Need for remote monitoring
- Telediagnostic system architecture
- Trenitalia actual remote monitoring framework
- Future improvements for remote monitoring

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Operation and Maintenance need

OPERATION

- Increasing of train availability
- Avoid faults during commercial service
- Train components reliability

MAINTENANCE

- Decreasing of time and cost consuming troubleshooting activities
- Optimizing of necessary resources (man power, spare parts, facilities, time)
- Reduction of maintenance costs

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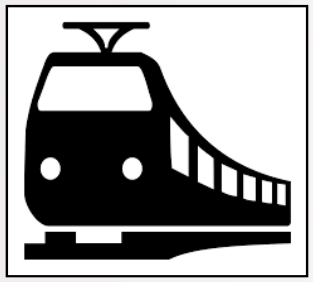
Legacy systems problem



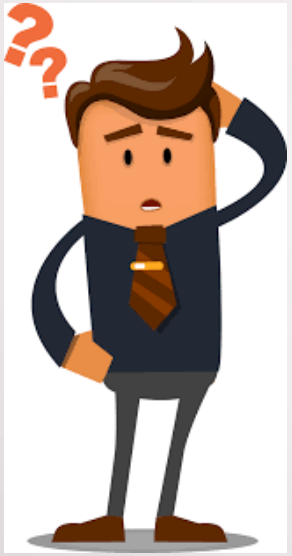
TRAIN

- Unavailability of command and control data
- Diagnostic data memorized and resident on control boards

MAINTENANCE

- Manual discharge of diagnostic data using special tools
- Time for analysis and troubleshooting activities

Need for remote monitoring



HOW CAN WE …

- Know the train status on real time?
- Remotely analyze diagnostic and process data?
- Anticipate as much as possible the evidence of incipient faults towards maintenance/operation staff?
- Make the maintenance process less time consuming (troubleshooting, diagnostic data download)?

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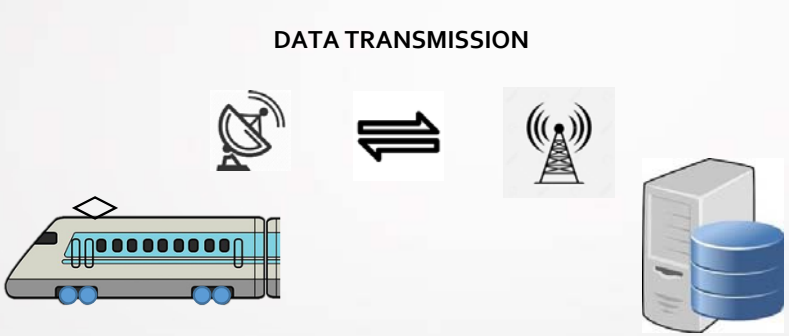
Need for remote monitoring



MAINTENANCE
- Remote diagnostic data download
- Automatic Notifications

OPERATION
- Dashboards

ENGINEERING
- Real Time Data Analysis
- Diagnostic Algorithms
- CBM Algorithms

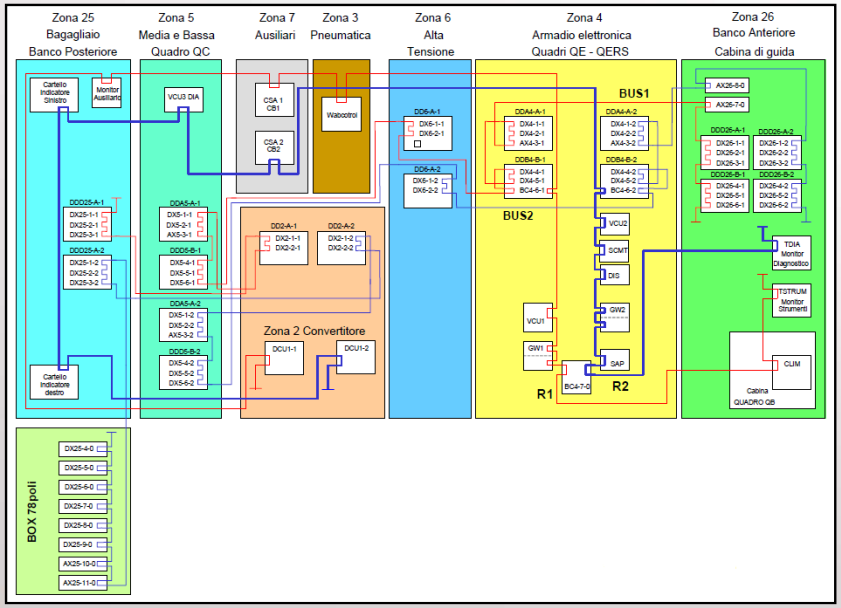
WE NEED …

- **TELEDIAGNOSTIC SYSTEM!**

Telediagnostic system – The OnBoard system

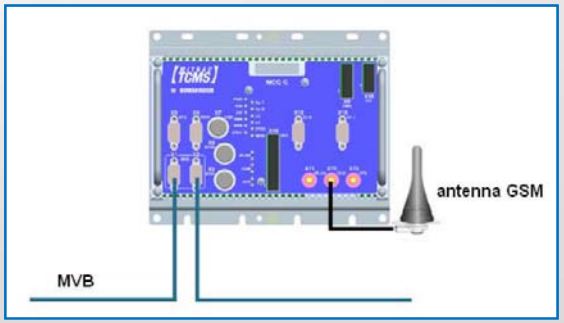
TRAIN BUS ARCHITECTURE

- VCU1 & VCU2 → redundant Command & Control units
- VCU DIA → Diagnostic unit



TELEDIAGNOSTIC CONTROL BOARD (MCG)

- Automatic export of data coming from train bus (process data)
- Automatic discharge of diagnostic database (diagnostic data)
- Remotely configurable
- Real time knowledge of train status



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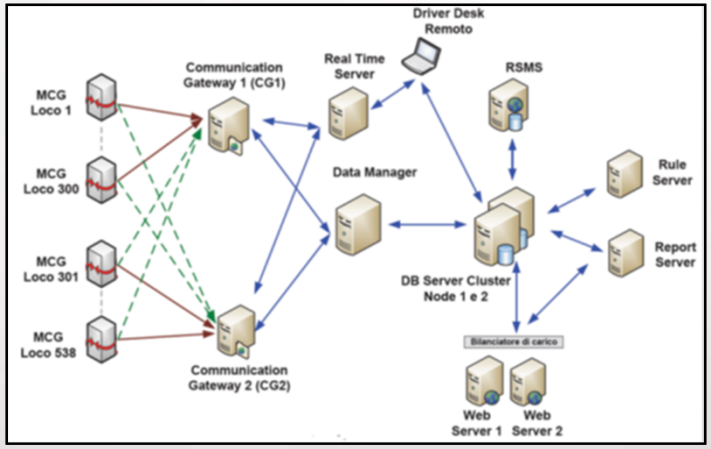
Telediagnostic system – The Ground system

COMMUNICATION GATEWAY

- Receive diagnostic and process data from trains

MCG

- Telediagnostic unit (OnBoard system)



DATA MANAGER

- Codify all diagnostic and process data
- Manage the storage on **DB SERVER**

RULE SERVER

- Automatic notifications design for maintenance staff

WEB SERVER

- User interface for analyze diagnostic and process data
- Monitoring of fleet/train status
- Creation of new diagnostic data

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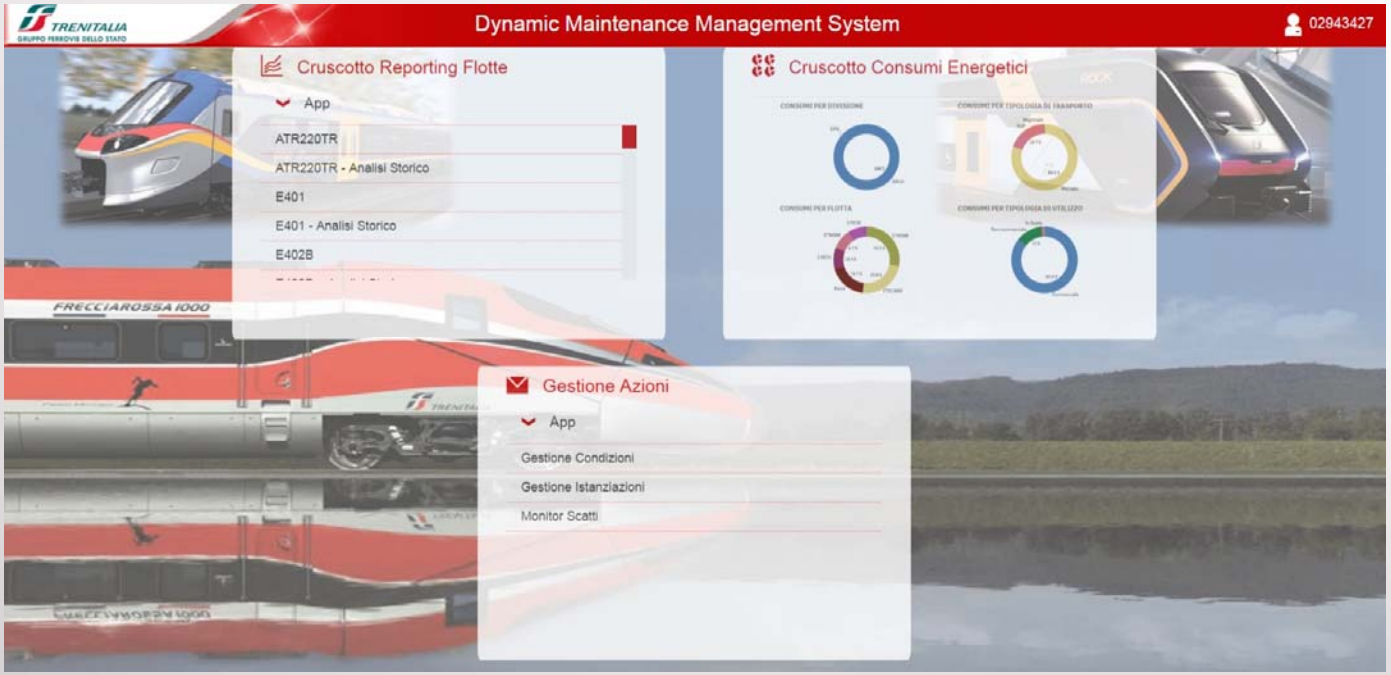
Trenitalia actual remote monitoring framework



- Operation Dashboards
- Fleet status report
- Process data & diagnostic analysis
- Implementation of Indicators for Condition Based Maintenance
- Automatic notifications design for maintenance staff
- Energy consumption Dashboards

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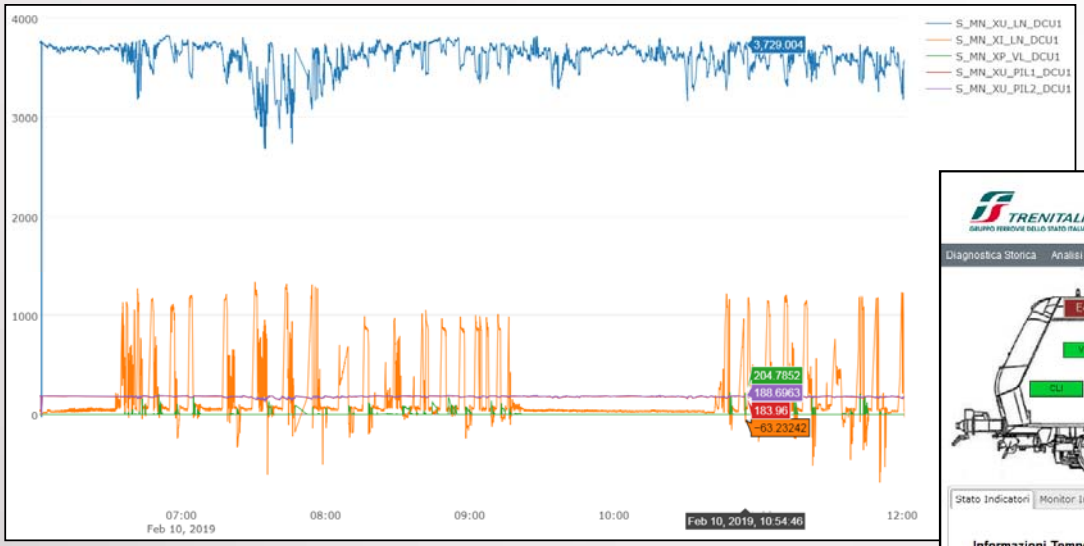
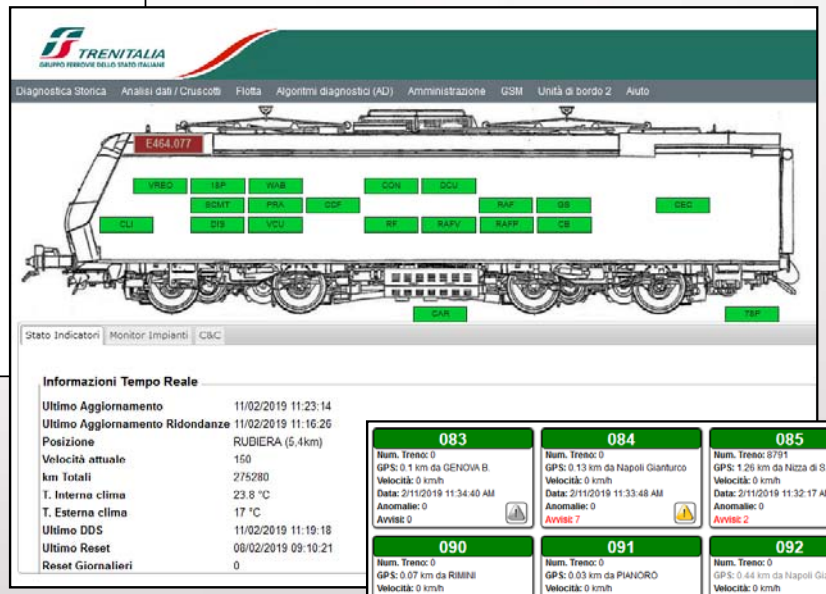


PROCESS DATA ANALYSIS

- Sampling time of recorded data **1 Hz**:
- ✓ Compromise between large amount of **data to be stored** on database and **dynamic of phenomena** to be recorded and analyzed

OPERATION DASHBOARDS

- Data updates time from **5** to **10 minutes**



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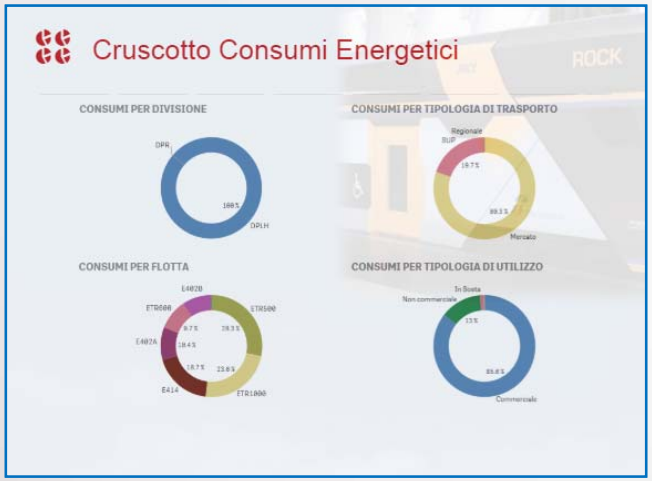
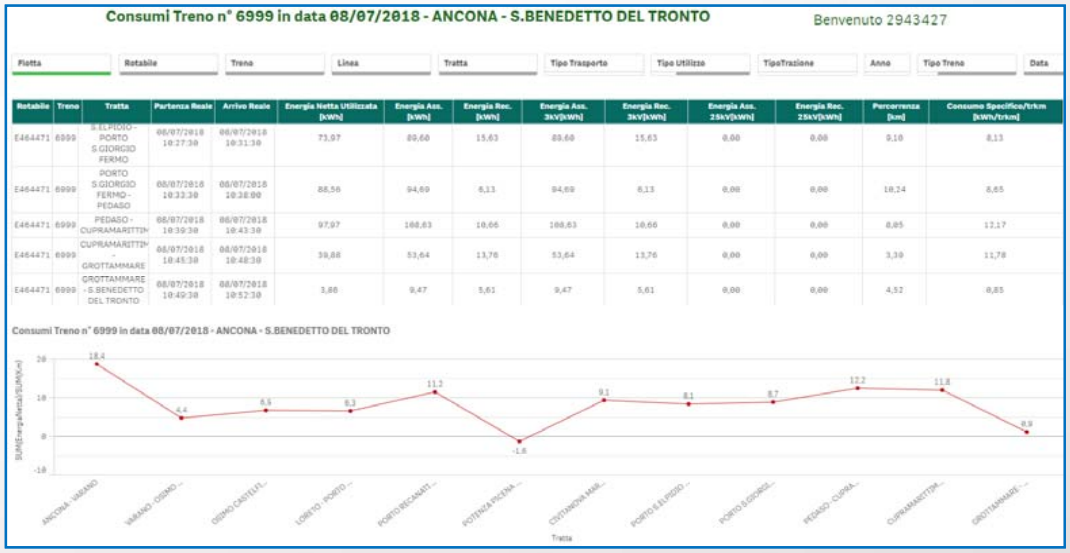
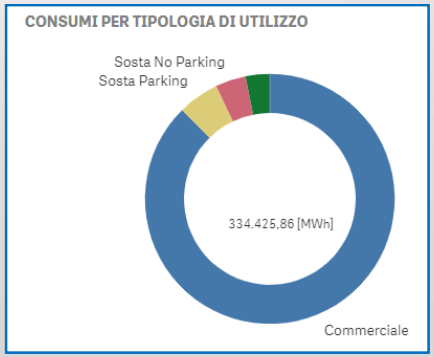




ENERGY CONSUMPTION DASHBOARD

- ✓ for fleet
- ✓ for type of service (commercial, parking, …)
- ✓ for train number
- ✓ net energy
- ✓ effect of delays



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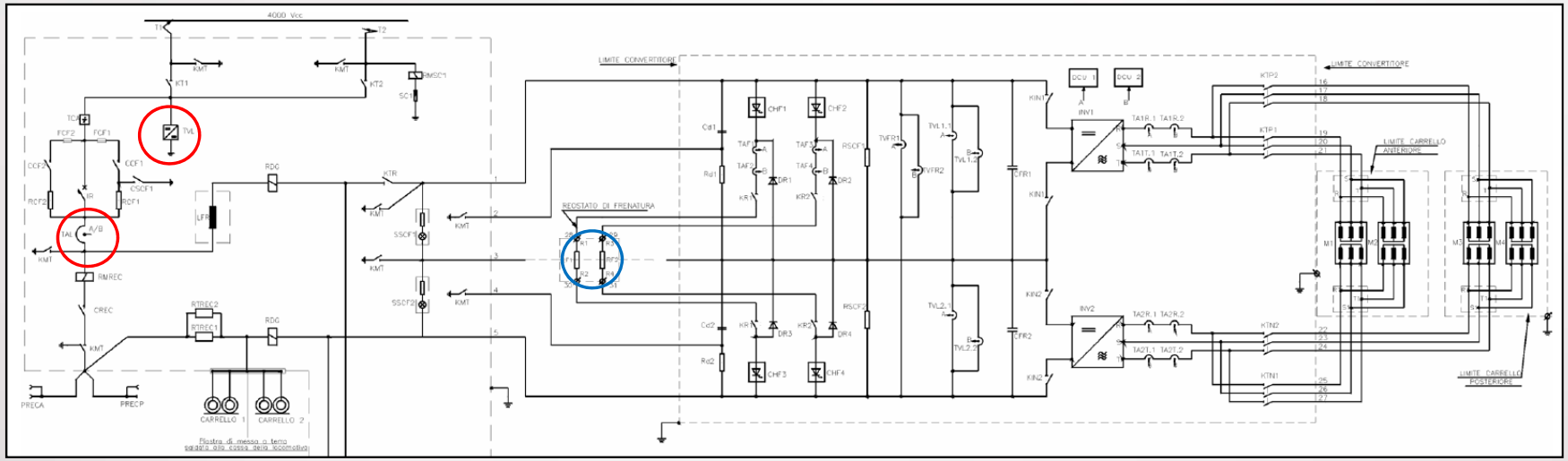
E464 locomotives remote monitoring

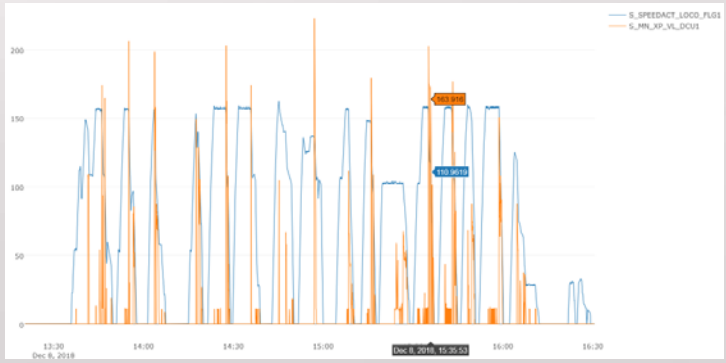


LINE POWER

- Line voltage [V]
- Line current [A]

BRAKING RHEOSTAT

- Power dissipated [kW]



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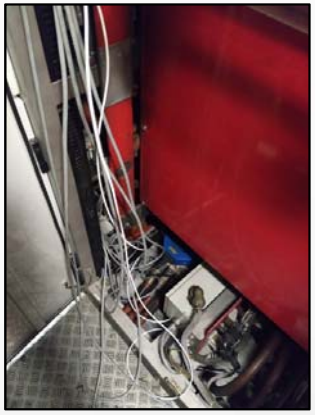
Future improvements for remote monitoring



BRAKING RHEOSTAT

- Voltages and currents acquired by external sensors (kHz sampling frequency) for:

✓ having a measurement carried out continuously

✓ computing the real **energy dissipated during rheostatic braking**

LINE POWER

- Line voltage and current acquired (kHz sampling frequency) for:

✓ a more **accurate** measure of **energy consumption**

✓ **arc monitoring** due to pantograph/catenary interaction

✓ pantograph stripes wearing model upgrade

✓ **power quality** measures

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… Thank you for your attention !

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